Docket N°.:04306/0202707-US0
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Marcos Giovani Dropa de Bortoli et. al.

Application N°.:10/530,077
Filed: September 22, 2005

Confirmation N°.:7459
Art. Unit:4147

For: SUCTION VALVE FOR A SMALL HERMETIC COMPRESSOR

Examiner: D. G. Kasture

DECLARATION OF MARCOS GIOVANI DROPA DE BORTOLI UNDER 37 C.F.R. $1.132

MS Amendment
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

I, Marcos Giovani Dropa de Bortoli, being a citizen of Brazil, residing in Joinville, Santa Catarina, Brazil and being over 21 years old and as one of the inventors of the above referenced application, hereby declares:

1. I submit this Declaration in support of the patentability of the pending claims 1-8 of the above referenced application.

2. I am a Research Engineer, employed by Whirlpool S.A. - Compressor Division, Joinville, Santa Catarina, Brazil. I have been in this position for almost 24 years. I have been working with Finite Element Analysis since 1986. I performed the below analysis.

3. I have read and am familiar with the above referenced application, the Office Action issued by the U.S. Patent and Trademark Office dated January 16, 2009, the claims pending in this application and which are being considered as being

anticipated by US4061443 to Black et al. ("Black"), one of the references cited against the claims.

4. I understand that the Examiner has rejected the claims and has made the statement that: Claims 1, 2, and 5 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,061,443 to Black et al. ("Black") and as extrinsically evident from Shigley et al (non-patent literature "Mechanical Enginering Design") and that Claims 3, 4, and 8 were rejected under 35 U.S.C. §103(a) as being obvious over Black in view of U.S. Patent No. 4,764,091 to Ikeda et al. ("Ikeda").

5. I, after January 16, 2009 Office Action, performed further analysis to detail the bases for the attached figures in which it was considered the Whirlpool construction, a hypothetic construction of a blade valve combining Whirlpool solution and that of US4061443, cited by the Examiner. The attached figures show these constructions in relation the stress zones at the valves. Said figures were generated using the commercial Finite Element Software called "ANSYS". ANSYS is headquartered in Canonsburg, Pennsylvania, U.S.A., and has more than 60 strategic sales locations throughout the world. ANSYS employs approximately 1,700 employees, many of whom are engineers. More information about this software can be obtained from http://www.ansys.com. The use of the Finite Element technique is necessary in the analysis because there is not a theoretical solution for a specific valve geometry considered. Other aspect to use Finite Element technique is that the problem is not linear, that is, the force is not related linearly with the displacement. For this specific case of reed valves of compressors, the final displacement of the free end of the valve can achieved 40 times the valve thickness. The linear theory can be used until 1 or 2 times the maximum displacement versus valve thickness. More one reason to use Finite Element technique is to consider the presence of the gasket between the valve and the crankcase (vide figure 1). The gasket has a influence on the stress results on the valves. The main parameters for the finite element analysis are:

- shell element 93 for modeling the valve (SHELL93 is particularly well suited to model curved shells. The element has six degrees of freedom at each node: translations in the nodal x, y, and z directions and rotations about the nodal x, y, and z-axes. The deformation shapes are quadratic in both in-plane directions. The element has plasticity, stress

stiffening, large deflection, and large strain capabilities);

- solid element 95 for modeling the gasket (SOLID95 is defined by 20 nodes having three degrees of freedom per node: translations in the nodal x, y, and z directions. The element may have any spatial orientation. SOLID95 has plasticity, creep, stress stiffening, large deflection, and large strain capabilities);
- valve thickness: 0.203 mm;
- gasket thickness: 1.0 mm;
- material properties for the valve: elasticity modulus of 2.1e11 N/m^2 and Poisson's ratio of 0.3;
- material properties for the gasket: elasticity modulus of 2.1e9 N/m^2 and Poisson's ratio of 0.3;
- Includes large-deflection effects in the static analysis;
- The model has about 5,000 elements and 18,000 nodes.

6. The first analysis was done applying a force of 1 Newton on the central region of the suction orifice, considering the Embraco/Whirlpool configuration and the other based on US4061443 approach. The figure 2 shows the Embraco/Whirlpool geometry and the figure 3 the US4061443 geometry. The figure 4 shows the main differences between the two configurations. The main difference is the shape near the region where the valve extremity is fixed (assembled with the gasket). The Von Mises stress for Embraco/Whirlpool configuration (figure 6) is about 50% of the value calculated for other geometry (figure 7). Other important point is the location of the maximum value. The US4061443 has a specific point where the stress is concentrated, and it is not recommended for reliability purpose. All the other parameters were keep constant, as material properties and thickness. As conclusion of this analysis, it is possible to affirm that Embraco/Whirlpool configuration is able to support a load bigger then Embraco/US4061443 configuration.

7. The same analysis is done considering a application of 2mm displacement at the central region of the suction orifice. The Embraco/Whirpool configuration (figure 8) has about 65% of the Von Mises stress of the Embraco/US4061443 configuration. The conclusion is that the Embraco/Whirlpool configuration is able to support a displacement bigger then Embraco/US4061443 configuration.

8. The figure 10 shows the stress analysis of the Embraco/Whirpool configuration with a displacement of 2 mm at the central region of the suction orifice. In this analysis, the problem was considered linear, that is, it was not considered the large-deflection effects , and it was not include the presence of the gasket. The results are totally different that was showed at figure 8 (the maximum value and the distribution of the stress). This analysis is very important to show the limitations of the use the classical theory of beams and linear analysis (as presented by Shigley et al - "Mechanical Engineering Design") to solve structural problems of reed valves. The results can lead to different conclusions than the ones obtained from more complex and realistic techniques, like Finite Element Method.

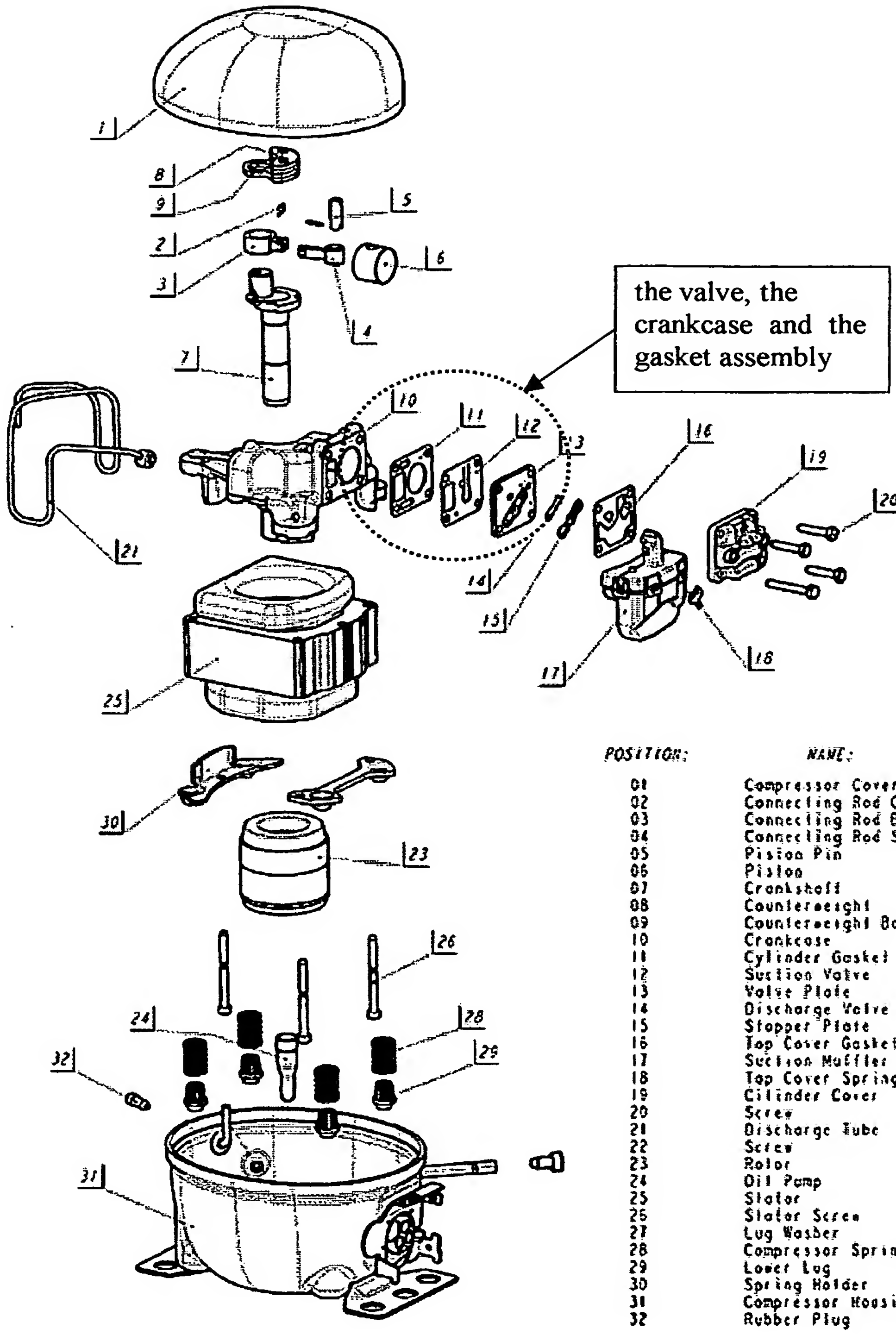
9. I further declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true. I further declare that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States code, and that such willful false statements may jeopardize the validity of the instant application or of any patent issued thereupon.

Date: July, 6th 2009

Respectfully submitted,

By:____________________

Marcos Giovani Dropa de Bortoli



POSITION:	NAME:
01	Compressor Cover
02	Connecting Rod Clamp
03	Connecting Rod Big End
04	Connecting Rod Small End
05	Piston Pin
06	Piston
07	Crankshaft
08	Counterweight
09	Counterweight Base
10	Crankcase
11	Cylinder Gasket
12	Suction Valve
13	Valve Plate
14	Discharge Valve
15	Stopper Plate
16	Top Cover Gasket
17	Suction Muffler
18	Top Cover Spring
19	Cilinder Cover
20	Screw
21	Discharge Tube
22	Screw
23	Rotor
24	Oil Pump
25	Stator
26	Stator Screw
27	Lug Washer
28	Compressor Spring
29	Lower Lug
30	Spring Holder
31	Compressor Housing
32	Rubber Plug

Figure 1 - A compressor exploded view

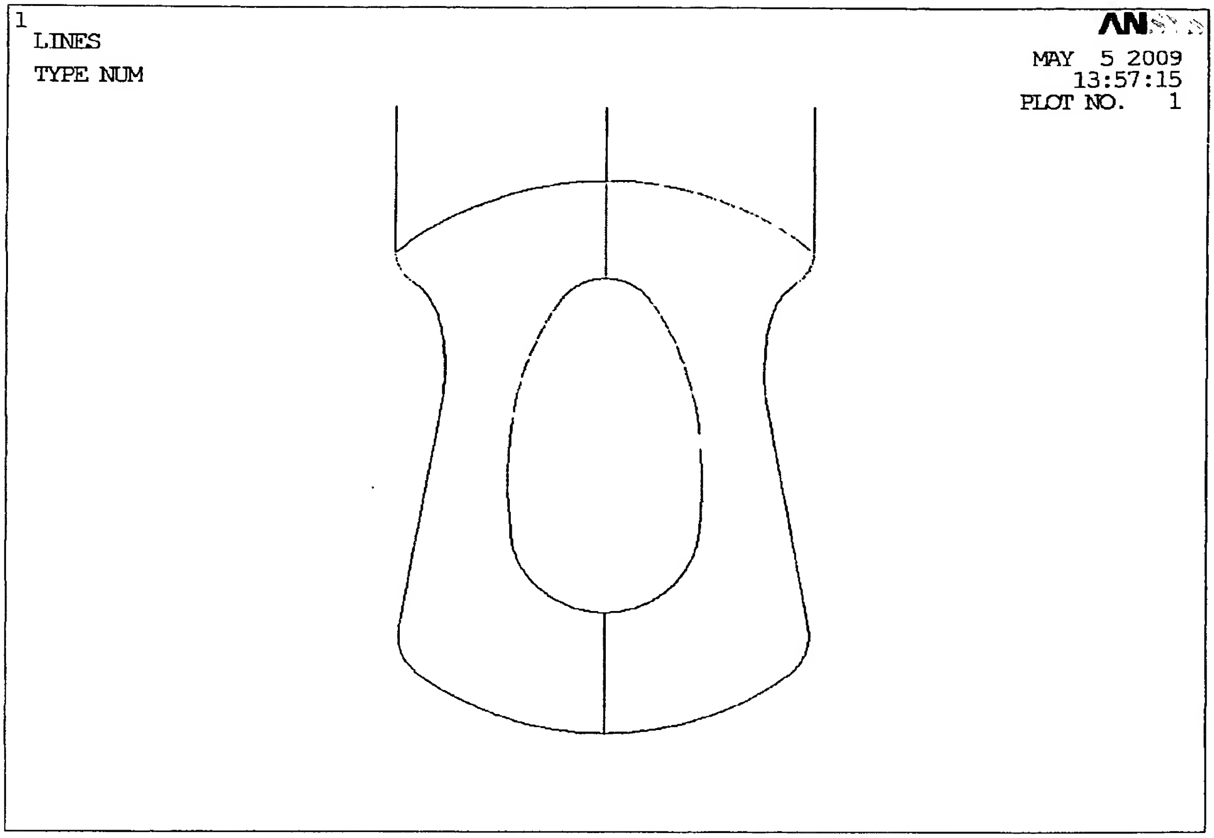


Figure 2 - Schematical valve of Whirlpool-Embraco solution

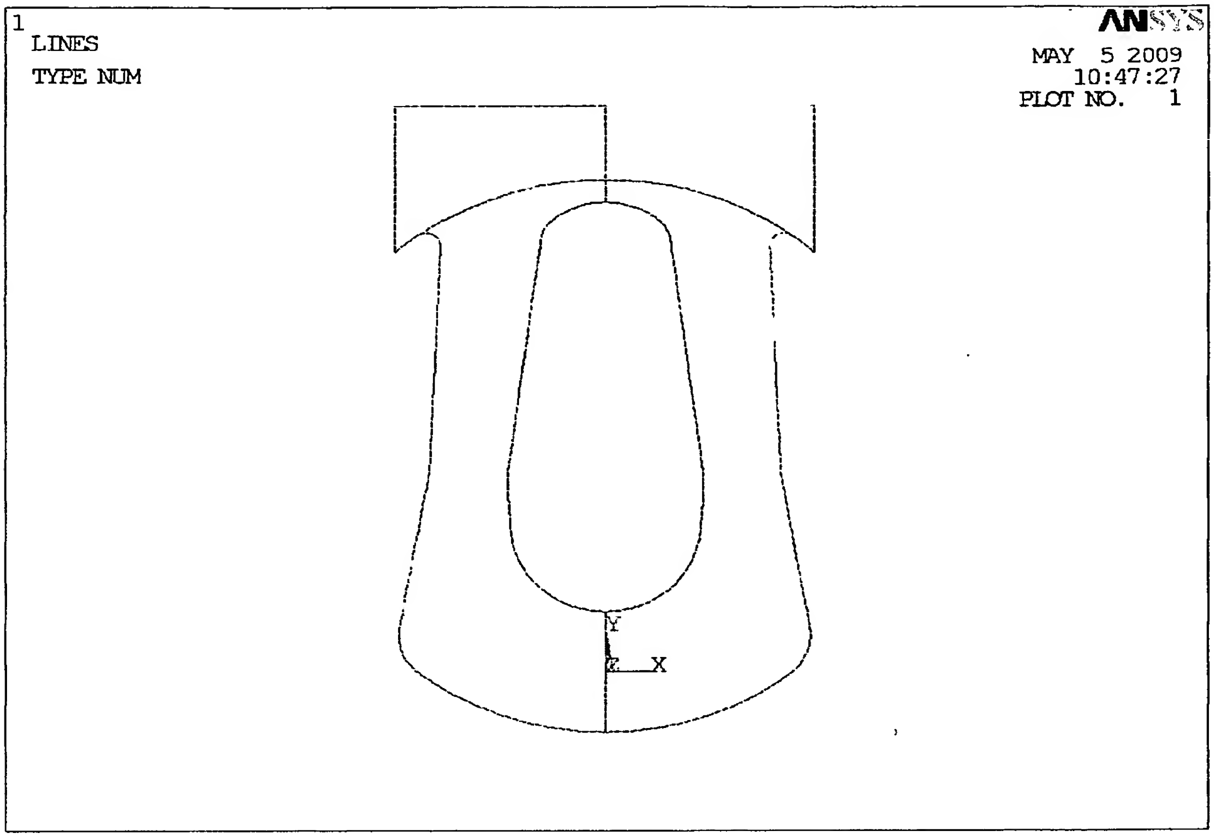


Figure 3 - Schematical valve similar to figure 2, to a valve resulted from a combination of Whirlpool-Embraco and with US4061443 solution.

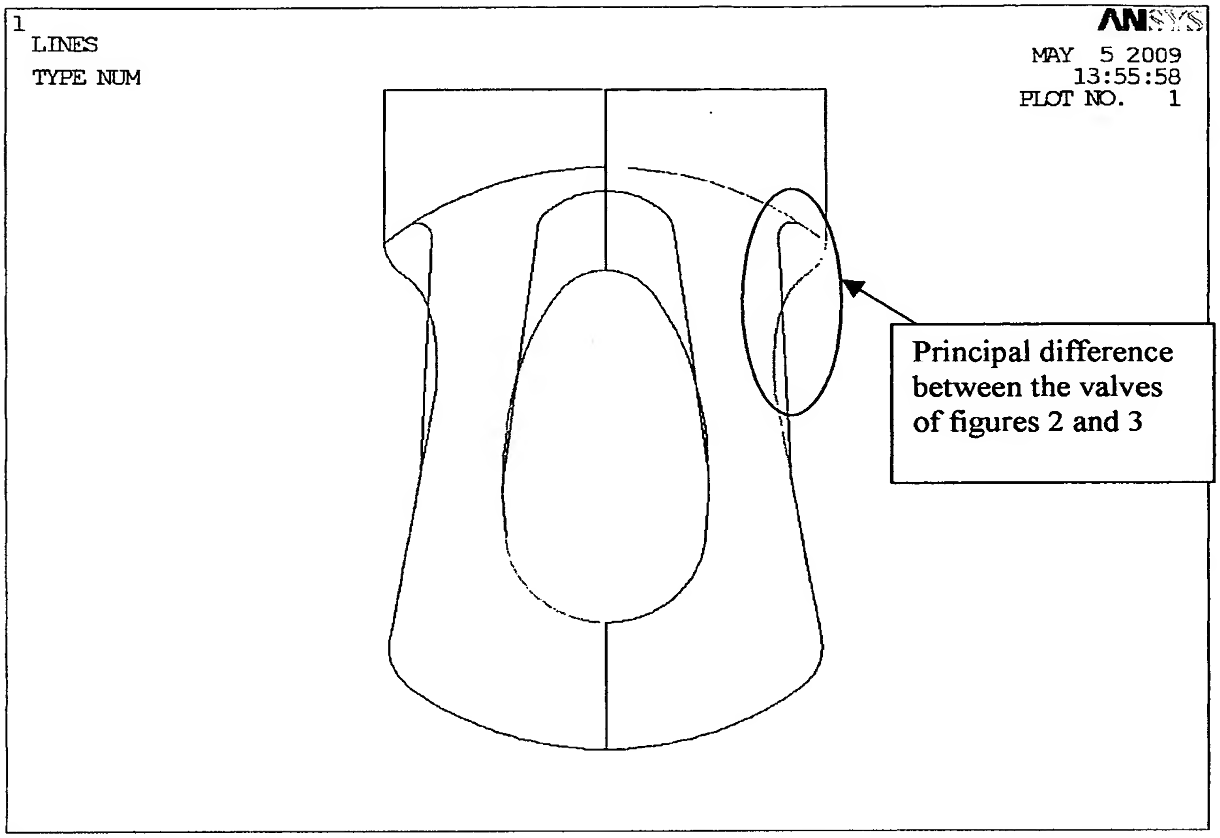


Figure 4 - Superpose Whirlpool-Embraco and combined (Embraco with US4061443) valve solutions.

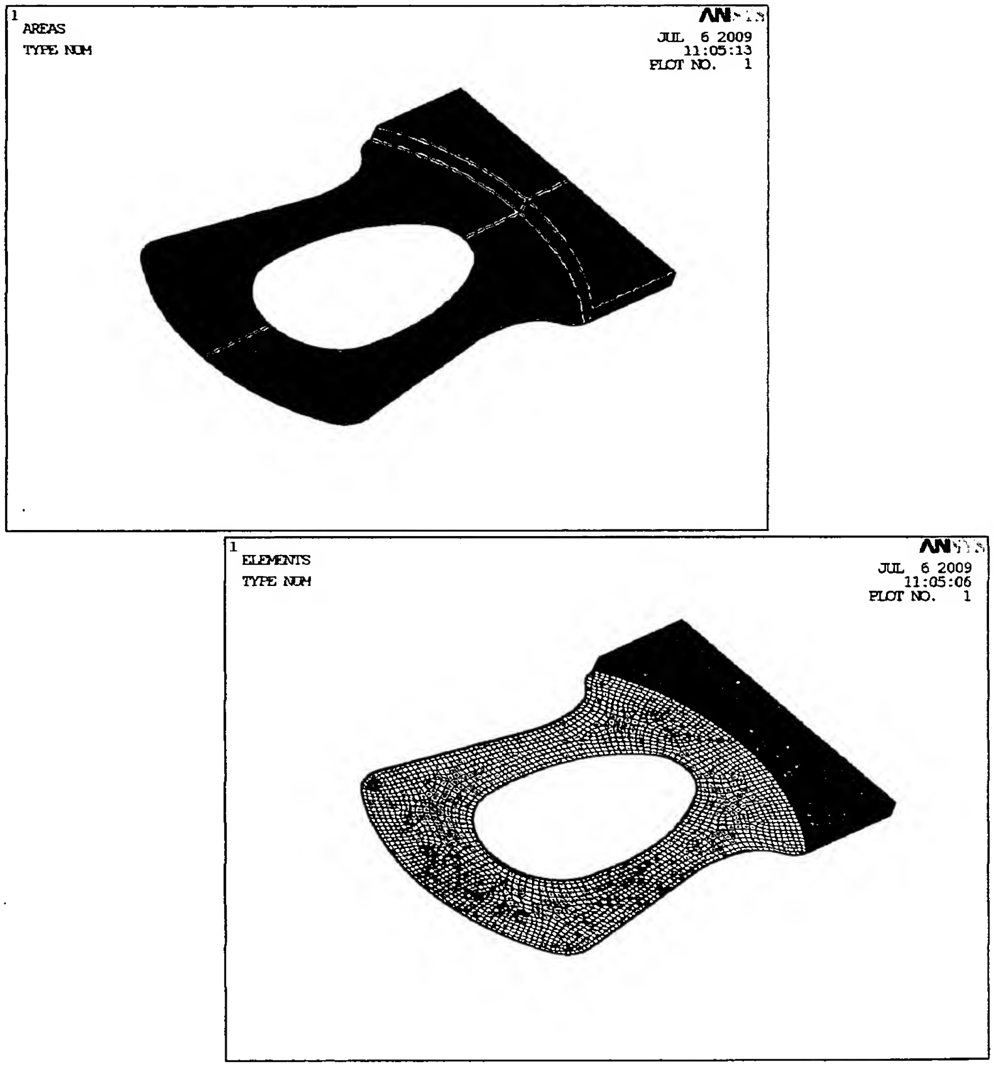


Figure 5 - Geometry and Finite Element Mesh for Whirlpool-Embraco valve (the model has the valve and gasket parts)

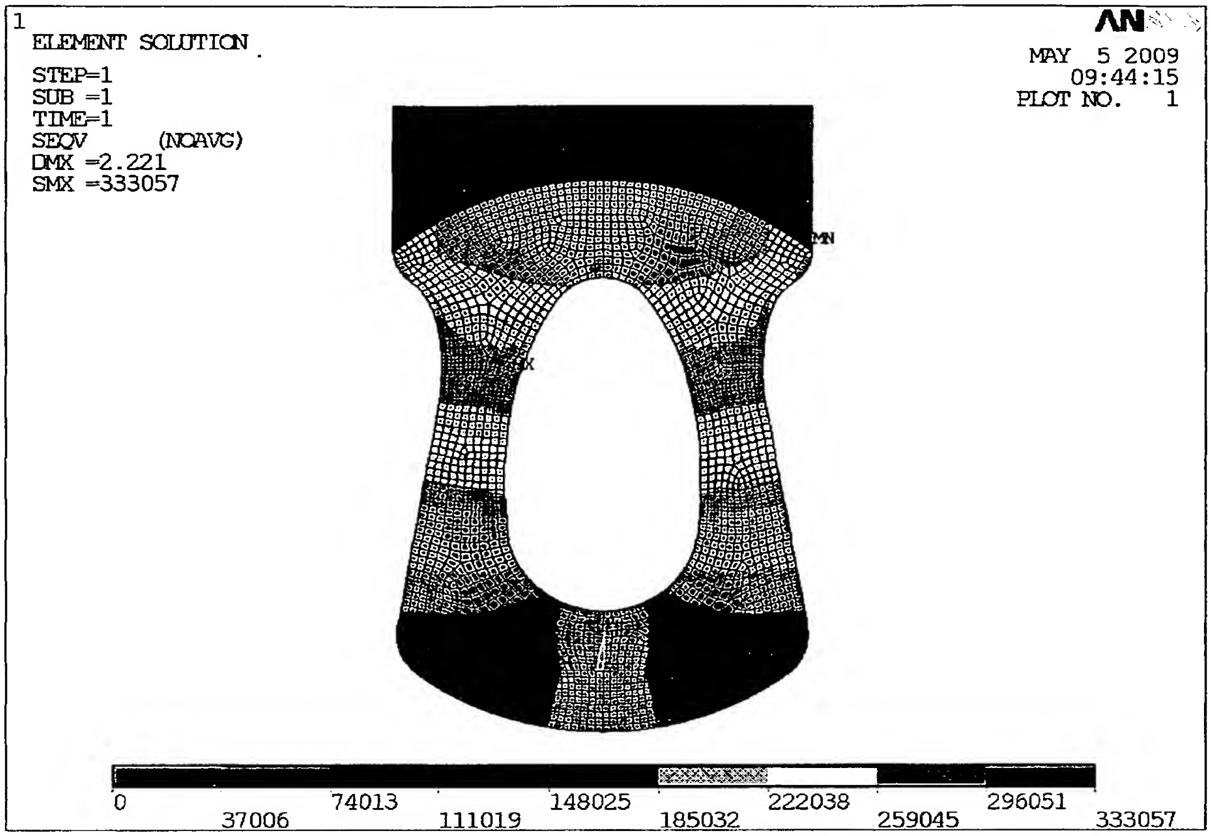


Figure 6 - Von Mises stress distribution to Whirlpool-Embraco valve solution (with a force of 1 N applied in the central region of the suction orifice)

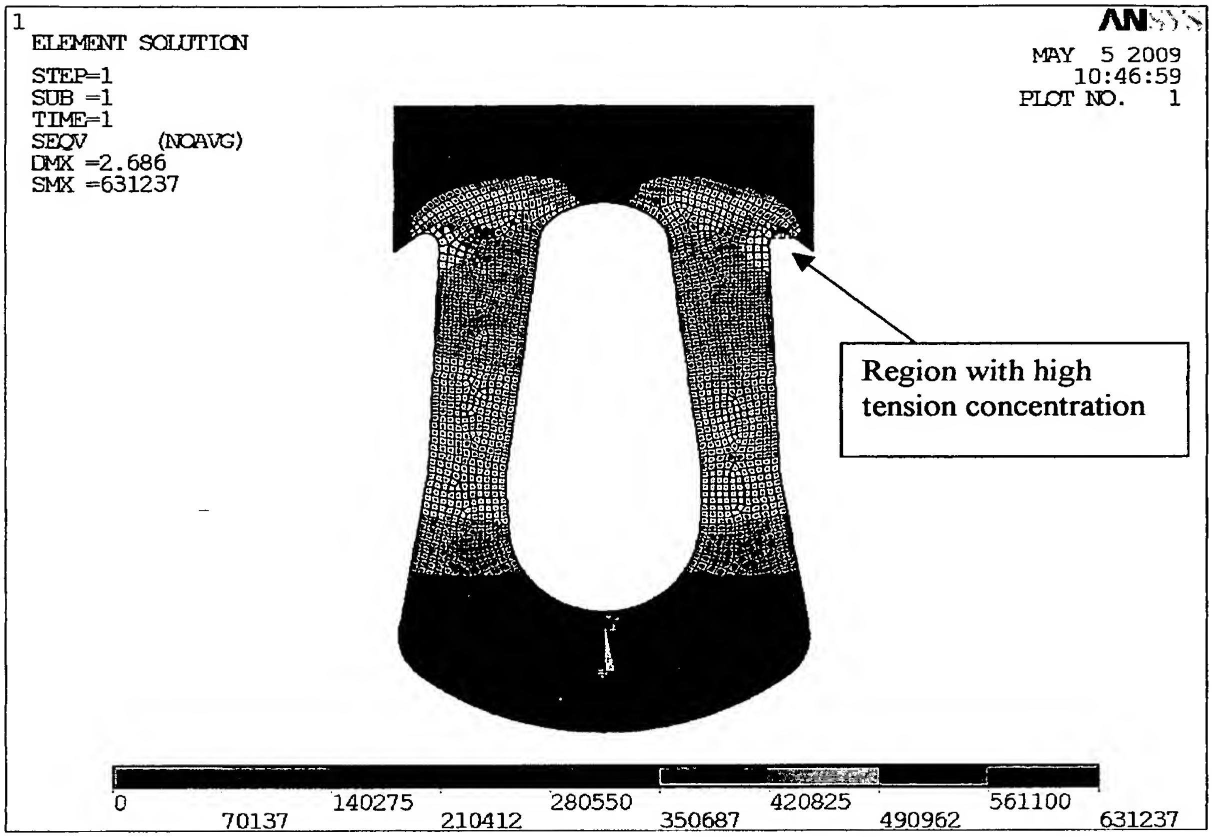


Figure 7 - Von Mises stress distribution to combined Whirlpool-Embraco and US´443 valve solution (with a force of 1 N applied in the central region of the suction orifice)

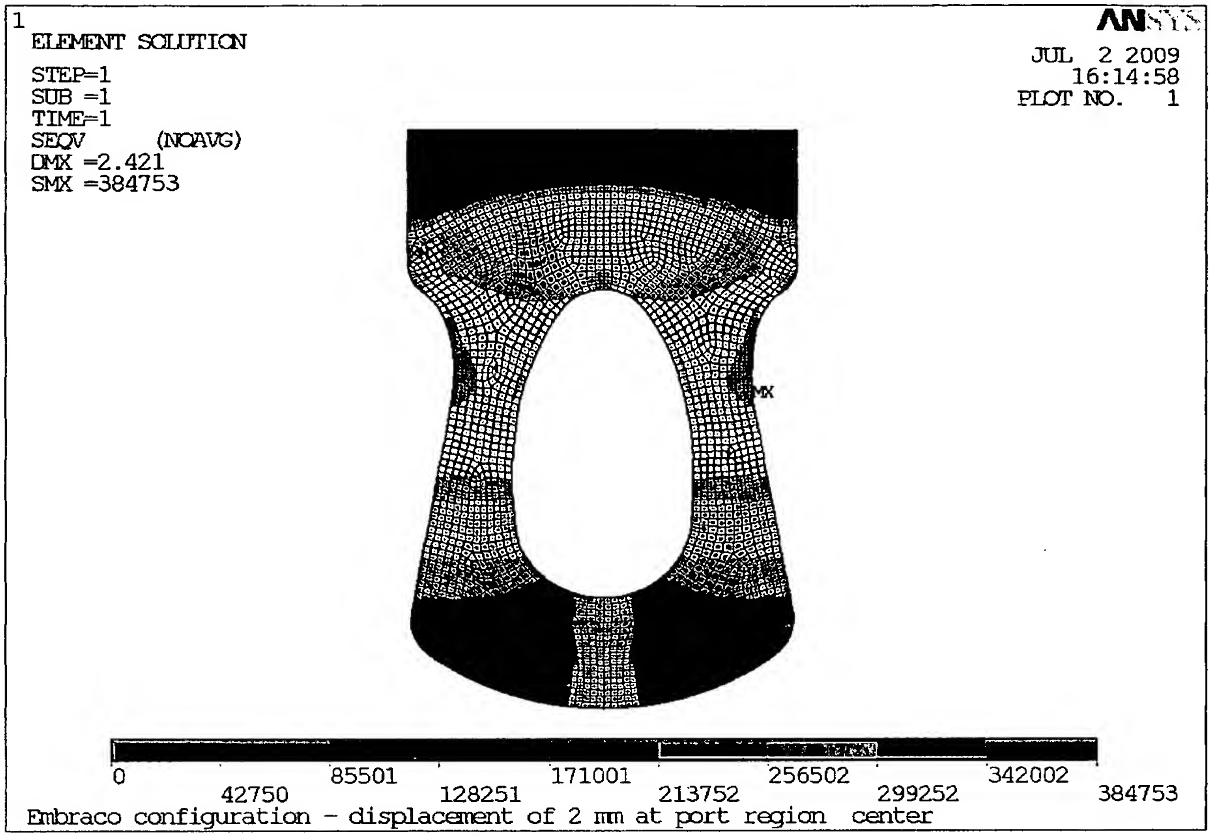


Figure 8 - Von Mises stress distribution to Whirlpool-Embraco valve solution (with a displacement of 2 mm applied in the central region of the suction orifice)

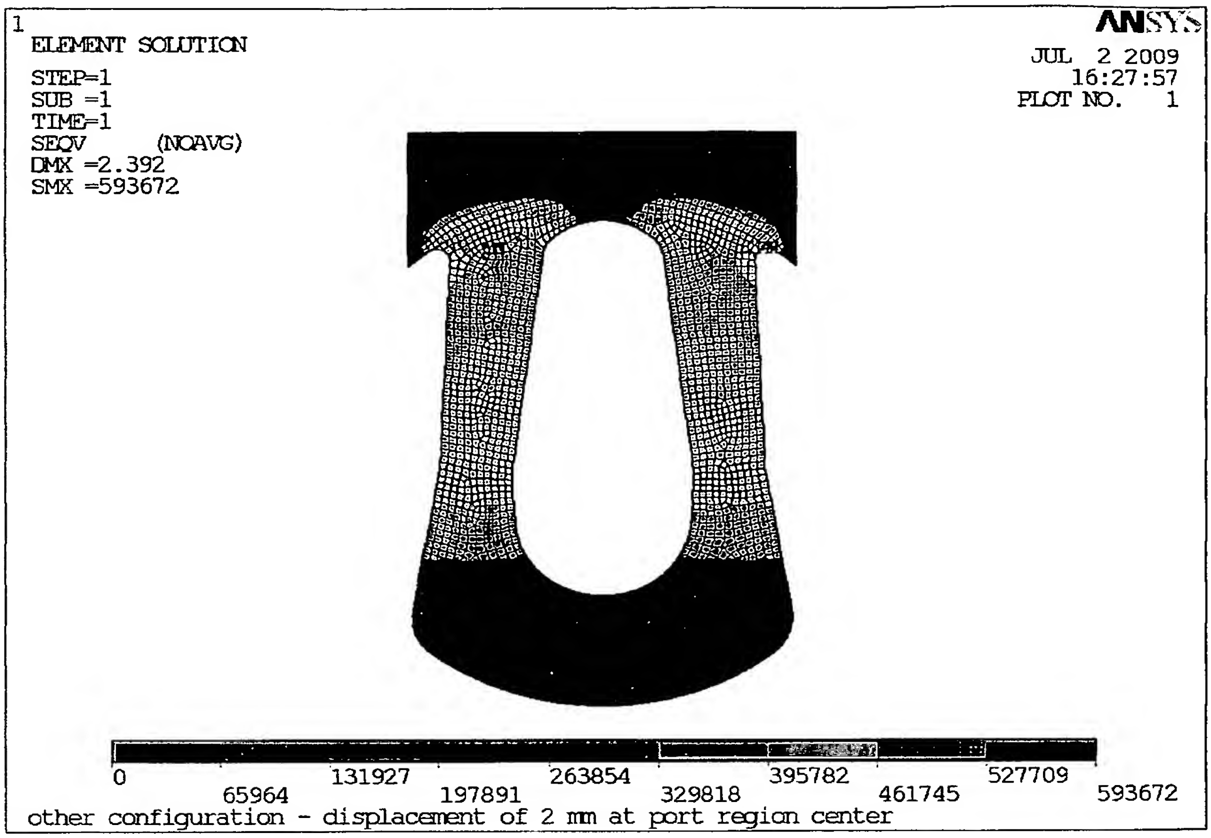


Figure 9 - Von Mises stress distribution to combined Whirlpool-Embraco and US´443 valve solution (with a displacement of 2 mm applied in the central region of the suction orifice)

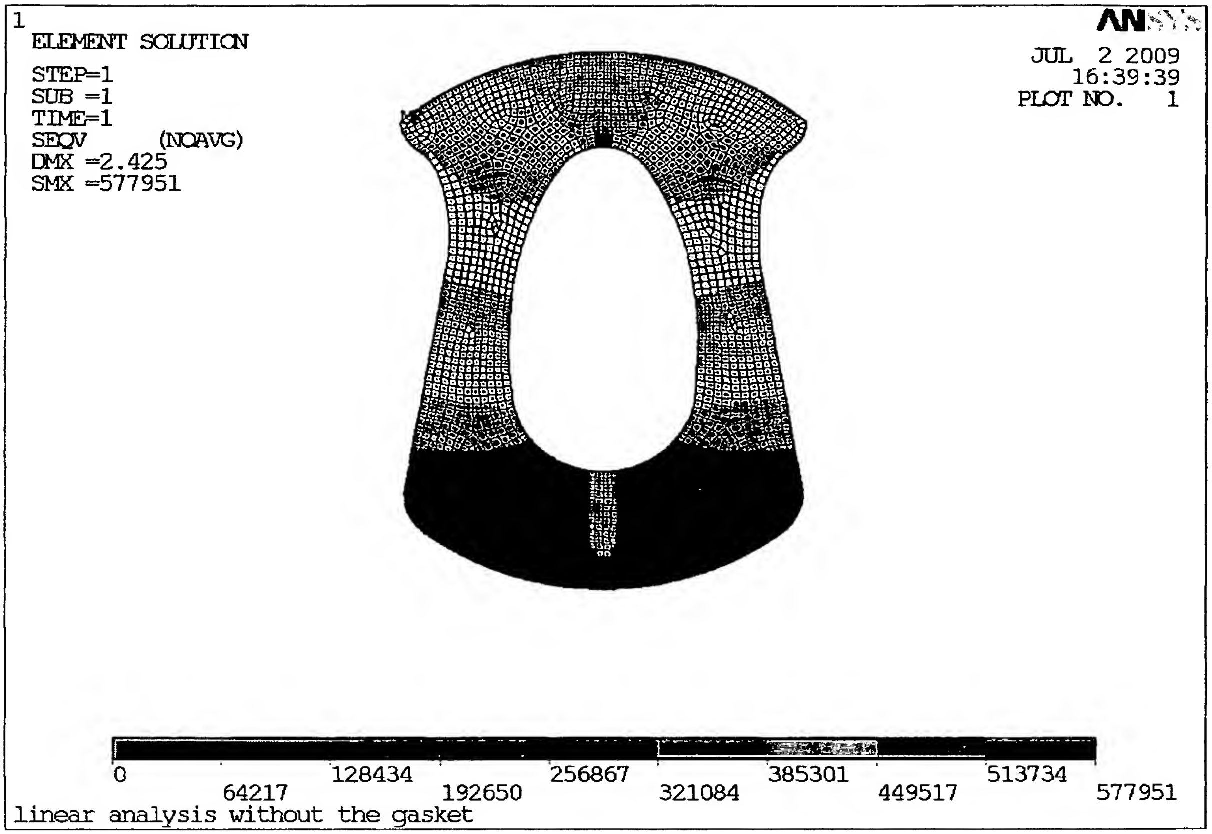


Figure 10 - Von Mises stress distribution to Whirlpool-Embraco valve solution considering linear analysis and without gasket (with a displacement of 2 mm applied in the central region of the suction orifice)